Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

High-speed laminar-turbulent boundary layer transition induced by a discrete roughness element[1] PRAHLADH IYER, KRISHNAN MAHESH, University of Minnesota — Direct numerical simulation (DNS) is used to study laminar to turbulent transition induced by a discrete hemispherical roughness element in a high-speed laminar boundary layer. The simulations are performed under conditions matching the experiments of Danehy *et al.* (*AIAA Paper 2009–394, 2009*) for free-stream Mach numbers of 3.37, 5.26 and 8.23. It is observed that the Mach 8.23 flow remains laminar downstream of the roughness, while the lower Mach numbers undergo transition. The Mach 3.37 flow undergoes transition closer to the bump when compared with Mach 5.26, in agreement with experimental observations. Transition is accompanied by an increase in C_f and C_h (Stanton number). Even for the case that did not undergo transition (Mach 8.23), streamwise vortices induced by the roughness cause a significant rise in C_f until $20D$ downstream. The mean van Driest transformed velocity and Reynolds stress for Mach 3.37 and 5.26 show good agreement with available data. A local Reynolds number based on the wall properties is seen to correlate with the onset of transition for the cases considered.

[1]Partially supported by NASA

Prahladh Iyer
University of Minnesota

Date submitted: 01 Aug 2013 Electronic form version 1.4